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FISHERIES

AN EXAMPLE OF THE ATTITUDE TOWARD RESOURCES

BY

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The attitude of a people toward their resources usually passes through four stages. At first, when population is scanty and resources in great abundance, men look upon their natural riches as unlimited in amount. Secondly, blinded by a seeming plenty, each community becomes recklessly prodigal in the use of its wealth. In the third place, as a result of long-continued waste there is a shortening of the supply in some one or more cases. This brings about a feeling of unrest and protest. Either immediate actual exhaustion threatens or timely Cassandra voices are sufficiently strong to bring about restrictive measures. Such measures seek to control the utilization of nature's gifts so as to conserve them. The final step is a concerted effort to replenish or restore the resource to its original abundance. In the United States there are many illustrations of the first three stages.

Our forests were considered so abundant as to be a positive detriment to spreading settlements. Natural gas was looked upon as arising from an unlimited reservoir in the earth's interior. New farms were to be had for the taking. As a result, lumber companies were allowed to slash their way unchecked through our forests with no thought except to cut the greatest amount of wood in the shortest time, regardless of injury to the forests or to the streams arising in the forests. Natural gas was allowed to escape into the air unused, or was transmitted in leaky, loose-jointed pipes to a city where it was burned continuously day and night. Farms have been single cropped until the soil fertility has been exhausted, or so carelessly plowed that the rains have washed the soil completely away. The growth of population, the advancing cost of living, the knowledge that multi-millionaires were being created by unrestricted private use of public wealth, and the actual dwindling of certain necessaries, called attention sharply to their limitation and the prevalent wastes. This condition gave rise to the conservation movement. But the movement is so recent in the United States that there has been, as yet, no adequate illustration of the complete restoration on land of those resources that lend themselves to replacement. To find a resource that has fully passed through all the four stages outlined above, we must leave the land and look in the sea. In fisheries we began with a great plenty which caused corresponding wastes. Then we had a period of uneasiness culminating in the cry for conservation. Finally has come a restoration of certain exhausted species.

PERIOD OF ABUNDANCE

In recounting the glories and possibilities of the new land he had discovered, Columbus laid emphasis upon the fish that abounded in its waters.* He claimed they would furnish a never failing supply of food. Similarly, a few years after Columbus, Cabot reported his discoveries to the King of England, and advanced as one of the reasons for considering his new found land of great importance the fact that the waters washing the continent teemed with fish. The English colony founded at Jamestown turned to the abundant supply of oysters and fish in the neighboring streams in periods of food shortage.† The Pilgrims in seeking permission from their King to found a colony in America based their claim on the fishing to be obtained of which wondrous tales had been brought home by whaling fleets.‡ Their colony was nearly as much a fishing venture as a seeking of religious liberty. As in the Virginia colony, the fish off their coast kept them alive when their harvest failed.§ Immigrants' letters were full of astonishment at the great quantity of fish in the waters of their new home. So plentiful were fish that they were considered poor food, fit only for servants or slaves. A gentleman would not eat fish until hunger forced him to it. Even the servants objected to eating too much fish. Apprentice indentures frequently bore a provision that an apprentice was not to be made to eat fish more than three times a week.‖ Fish that are to-day valuable as sources of food were then used for fertilizer. The abundance of whales and cod was the very foundation of the Massachusetts colony.¶ The state has recognized this fact by suspending a great model of the cod above the desk of the Speaker of House of Representatives, a sight which always causes comment by tourists. Tales of plenty are not confined to the colonial period but extend to the days of our own fathers. Such a fish as the sturgeon was caught in so great numbers as to be piled on shore like railroad ties, to burn or to decay.* There are many records of fish jumping into the open boats of the fishermen. Everywhere, then, there were fish in great plenty in American waters.

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* Fishing Industry of United States. S. Brown Goode.

† Fishing Industries of United States. S. Brown Goode.

‡ History of Whaling Industry. Walter S. Tower. Political Economy and Public Law Series No. 20.

§ Fishing Industries, U. S. Goode.

‖ Handbook. International Fisheries Exhibit. London, 1883.

¶ History, New England Fisheries. McFarland. D. Appleton & Co., 1911.

THE PERIOD OF WASTE

The greatness of the resource in fish has been equalled by the reckless manner in which it has been utilized. Our fishing has been like primitive hunting. All thought has been on present gain without any regard for future supply. In fishing as in hunting, when one region or species was exhausted, it was easy to move to another. This has been a world experience, so is not limited to United States. Ages ago, at the annual overflow of the Nile many fish were stranded. The Egyptians gathered only the largest fish for food, leaving the smaller ones on the banks to die. It was not long before there was a noticeable decrease in the number of fish in the Nile. There were no longer large fish in the receding waters. Then the Egyptians tried throwing the formerly despised little fish back in the river, an expedient which was successful in restocking the stream.†

In Greece also a species of fish like our mackerel, called "thunnier" by the natives, were driven into bays and lagoons in great numbers and there killed with sticks. Greece won fame as a fishing center, but shortly her waters were so depleted that fishermen had to seek elsewhere for their prey.‡

The shallow waters of the British Isles and the numerous estuaries that once abounded in fish have been so exhausted that fishing boats now have to go far from land for their hauls.

There are several reasons for over-fishing. In the first place man cannot resist gorging in the face of plenty. When there is more than enough, men take more than they need. Abundance breeds the idea that abundance will always prevail, so carelessness creeps in. When fish are plentiful they are cheap; in order to make a profit the fisherman must take large quantities. They cannot afford the time and care necessary to prevent waste. Attention is centered on making money quickly. As the supply of fish begins to dwindle the price rises, so men become more and more eager for large catches. The difference in price offsets wastes, so no attention is paid to preventable losses until some outside force compels more careful methods. The outside force may be legal governmental restrictions or it may be the exhaustion of the supply of fish.

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* Unparalleled Extermination of a Species. The Sturgeon. W. S. Tower. Popular Science Monthly, October, 1908.

† Fisheries and Fishes of All Nations. W. M. Adams. London Handbook, 1883.

‡ W. M. Adams. Fisheries and Fishes of All Nations. London Handbook, 1883. Great International Fisheries Exhibition.

There are many examples in the fish family of members once plentiful reduced to a few. Among them are the lobsters, shad, and oysters. Lobsters are taken to illustrate the working of the law of extermination in the sea. Shad, salmon and sturgeon show the same process at work in rivers, and oysters prove that bays are not exempt from man's aggressive greed.

(A) THE LOBSTER*

Lobsters were once abundant all along the Atlantic coast from Delaware Bay to Labrador. The chief centers, however, were off the coasts of Maine and Nova Scotia, because the lobster prefers cool water, and a rocky bottom, where there is a greater likelihood of food. The lobster is the goat of the sea, eating anything, alive or dead, vegetable or animal. In the Maine region lobster catching has been an important business for more than a century. Catches have been enormous, amounting in 1889 to 30,000,000 pounds.† The lobsters, too, were of large size—often attaining twenty pounds apiece, and sometimes as high as forty pounds—a contrast to our present two pounders. The delicate flavor, so widely popular, the ease of catching and the great numbers caused lobstering to be conducted on a large scale. The lobster was able to resist its natural enemies, but when man was added, the fight for existence was too unequal and almost total extermination took place. The female does not produce eggs until she is three or four years old, and then produces only at two-year periods. After the eggs are extruded from the body they are carried for nearly eleven months in the tail of the female. With such a precarious existence it is surprising that lobsters survive at all, but nature has adjusted a nice balance between reproduction and extermination. When man appears as an enemy he upsets nature's balance. He takes all kinds of lobsters, large and small, male and female, with or without eggs; so it is only a question of time when lobsters cease to exist. The 30,000,000 pounds taken in 1889 shrank to 15,000,000 in 1898† and continued to decline until recently, when artificially propagated lobsters began to appear in the catches. As the quantity of lobsters declined, the price per pound went up. In 1880, lobsters sold for 3.6 cents per pound.

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*Reports, U. S. Fish Commission. Ency. Britannica. New International Ency. Fishing Industries, U. S. S. Brown Goode.

† Statistical Abstract of U. S.

In 1898 the price was 8.7 cents and in 1908 it had reached 12 cents.* So as man's operation began to show in a declining supply the search for lobsters became more and more keen. Protective laws were flagrantly violated in order to supply the hotels and the homes of the rich with the delicacy they demanded. The lobsters were in danger of utter annihilation. The efforts to prevent extermination are told later in this paper.

(B) THE SHAD

There is a group of fish,—called anadromous—that begins life in a river, goes out to sea to live and returns to the river to spawn. To this family belong the salmon and the shad. The story of the river-seeking shad is similar to that of the sea-dwelling lobster.

The shad, at one time, ran in all the Atlantic rivers from the Gulf of St. Lawrence to Florida, but chiefly in Chesapeake Bay and its tributaries and in the Delaware, Connecticut and Kennebec.† An allied species ascended the Mississippi River as far as the Ohio. They were also found in the streams discharging into the Gulf of Mexico.† Shad were so plentiful that only the poorest people ate them. They were used principally for fertilizer. Their chief value lay in the fact that as the young shad made their way from the river to the sea they attracted inshore the deep sea cod and halibut, thus avoiding the necessity for long sea voyages to catch the latter. As population increased and pressure upon food resources became greater, the shad were used for food. Since the shad forced their way up the river in great schools to spawn, their capture was easy. Every wholesale catching device was used. Nets and other obstructions were stretched across the rivers, especially near the river mouth. On the Potomac one net took 3,600 fish at a single haul.‡ One seine net caught 11,000 shad in a week on the Roanoke River in 1895.§

In each of the chief rivers the average daily haul was never less than 3,000 fish. Explosives to stun and kill the fish added to the catches by net.|| Very few fish reached the spawning grounds. The offspring of the few which did survive had a hard struggle to live. Many of the streams in which shad ran were used to dispose of the sewage of surrounding towns. The water thus polluted poisoned the young shad.¶ Saw mills emptied their dust into the streams. This caught in the gills of the fish, suffocating and poisoning them.**

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* Statistical Abstract, United States.

† Communication Commissioner Fisheries, 1912.

‡ U. S. Bureau Fisheries. An article by Hugh Smith, pub. by the dept. for the International Fisheries Congress in 1908.

§ Shad Fisheries of Atlantic Coast. U. S. Fisheries Bureau.

|| Report Maine Fish Commission, 1906.

¶ Report Penna. Fish Commission, 1906.

** Report Maine Fish Commission, 1903-04.

Farming operations on the banks of the streams so muddied the waters that the young fish were choked.* So it was a lucky fish that escaped to sea with its life. As railway building extended markets, as better methods of canning were adopted and as uses were found for former waste products, the tackle and methods of catching the shad were vastly improved.† Since all the fish were taken before or during the spawning season, few reached the spawning grounds. Added to all the other agents of destruction was the obstructing of streams with dams to develop water power. It is no wonder that the run of shad in some rivers ceased altogether, and in all rivers was greatly decreased. The Connecticut rivermen used to sell 500,000 shad a year. To-day they sell considerably less than 50,000.‡ The efforts to restore the shad fishery belong properly to another section of this paper.

(c) THE OYSTER§

The denizens of the sea have suffered at man's hands, the residents of the river have been nearly exterminated by him. The humble dwellers in the bays have not escaped. The oyster can be found all along the Atlantic coast from Texas to Massachusetts. Its real home, however, is in Chesapeake Bay with Baltimore as the largest canning and shipping center. Special trains running on the schedule of the fastest expresses carry oysters nightly from Baltimore to Chicago and St. Louis. Man has been the oyster's most dangerous enemy, for in his haste to make large profits man has taken away from the beds all kinds of oysters, large and small. Not enough are left to perpetuate the stock. An oyster grows an inch or more a year until about four years old, then grows more slowly. They should not be taken from the beds until the maximum size is reached. Enough oysters should in any case be left to carry on reproduction, and to provide fastenings for the young oysters. As in forests, the amount taken away each year should not be more than the growth for that year. But man has too frequently taken all the oysters from a given bed. So extensive was this practice that the danger of annihilation was serious. Only the work of states and especially of the United States Fish Commission has prevented this calamity.

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* Shad Fisheries of the Atlantic Coast. Bureau Fisheries. † Fisheries of U. S. S. Brown Goode.

‡ Statistical Abstract, U. S. § Oysters and Methods Oyster Culture. H. F. Moore. U. S. Fish Comm.; Condition and Extent of Natural Oyster Beds of Delaware, Doc. 745; Oyster Culture Experiments in Louisiana, Doc. 731; Condition and Extent Oyster Beds James River, Doc. 729; Volumetric Studies of Food and Feeding Oysters. Bureau Fisheries.

CONSERVATION*

About the middle of the last century, much uneasiness was felt concerning the wholesale destruction of our fish. The States first tried to prevent some of the waste by legislation. Fines were imposed for taking fish under certain size, with eggs, or at certain seasons of the year. These laws were not very effective, because they were too easy to evade. The unrest finally crystalized in an Association of those most interested in fisheries. Through the efforts of this Association, Congress in 1871 created the United States Fisheries Commission. The Commission's first work was an investigation of all commercial fish along the Atlantic coast and Great Lakes. The study was thorough. All the factors concerning fish were investigated, the habits of the fish, its enemies and friends, the effect of currents and temperature, the migration habits and causes for migration, the methods of reproduction and growth. A study was made of fishing grounds so as to extend fish resources, and obtain greater yields with better conditions. Types of vessels and fishing gear were carefully tested so as to recommend ways of avoiding wastes. Experiments were made with the various parts of the fish so as to make as much as possible salable and as little as possible waste material. Methods of transporting, canning and preserving fish were investigated so as to cut down loss. Foreign experience was drawn upon to help solve domestic problems. Finally, a fish pathologist has been employed to study the cause and cure of diseases in fish. The work has been carried on by the Commission itself, by experts it has called in from time to time, and by volunteer scientists. The examples chosen for this paper, the lobster, shad and oyster were among the earliest to be thoroughly investigated in the ways outlined.

RESTORATION

At first the United States Fish Commission was an investigating body purely, but the second year of its existence it was authorized to propagate fish. This has since been the largest part of its work. Eggs that would otherwise be lost are taken from fish caught for market and hatched at the government hatcheries. The fish hatched from the eggs are first made to replenish streams or waters from which the eggs came. Then the various State Commissions receive supplies of eggs. Finally, private individuals, through their Senators or Representatives, may obtain fish to stock private or public waters.

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*Work of U. S. Fish Commission. S. B. Goode. London Handbook. Bureau of Fisheries; Hugh Smith. *Nat. Geog. Mag.*

Before man's interference nature had adjusted the reproduction of fish to their extermination by natural enemies. When man was added as an enemy he upset the balance and so nearly exterminated the fish. Now in the capacity of friend, man is going to the other extreme in his efforts to replenish the fish supply. He offsets the natural enemies. The most dangerous period for any fish is during the earliest stages of its life. In the case of the lobster, as soon as the eggs are hatched, the young spend their first three months swimming as larvæ on the surface of the water. At this period they are devoured in countless numbers by surface swimming fish. At the end of the larvæ span the young lobster sinks to the bottom of the sea, and becomes the prey of every ground feeding fish. In periods of stress, even the adult members of its own family eat it, for lobsters are atrocious cannibals. During the first year the lobster molts or changes its shell seventeen or eighteen times. Each molting is a dangerous period and the mortality at such times is high. During the body change the lobster is without its natural hard shell protective covering and so is peculiarly defenseless. Artificial reproduction saves young lobsters from many of these vicissitudes. There are no natural enemies in the tanks of the hatcheries. Even the molting stages are carefully guarded, so a lobster that begins life under artificial conditions has a far greater chance of surviving than if hatched naturally. Lobsters are not planted until their most dangerous period is over, and they are able to meet natural enemies, well protected.

Similarly it is better for a shad to start life in a tank than in a river. Shad do not copulate. The female sheds spawn into the water and the male extrudes milt. If these two meet the eggs are fertilized. There is much loss of eggs by failure of the spawn and milt to intermingle. Spawn and milt are also eaten by other fish and by insects. Under artificial conditions the mingling can be controlled and so there is surety of the eggs being fertilized. Insects can be screened. In the river, if the eggs are fertilized, they sink to the bottom where eels devour them in quantities. Floods and receding waters destroy countless eggs. After hatching, muskrats and larger fish prey upon the infant shad, and at the river mouth, cod and haddock hungrily await their coming. In the hatcheries there are no eels, no muskrats, no fish enemies, no floods and no receding waters, so young shad hatched artificially do not have to run the long gauntlet that their relatives of the river must pass in order to live. So the number of shad that reach the planting size is much greater under hatchery conditions than under ordinary conditions. Man then is a benefit to the fish by protecting it from a host of enemies during infancy, when it is most likely to lose its life. Before 1880 shad decreased in every river along the coast. Artificial propagation has stopped the decrease, and in spite of more efficient fishing gear, shad are once more so abundant that there is no species of fish more important to residents of the entire Atlantic seaboard.*

Especially equipped tank cars, six in number, are used to transport young fish wherever railroads go, and large cans, like those used for milk, carry the fish from the railway station to the place of planting. Sea work is done by a large vessel, the *Albatross.* For inland or river work the *Fishhawk,* a small boat, is used. The Commission owns several still smaller craft.

Hatcheries have been established at points where special fish were being exterminated. For several years lobsters have been systematically hatched and planted along the Maine coast. This artificial propagation is just beginning to show in the catches. Fishermen report more and more numerous young lobsters; so the tide of annihilation has been turned and soon artificial reproduction may overtake consumption. Man will then have restored the balance of nature which he had so rudely upset. Shad have been kept running by establishing hatcheries near streams that long ago would have been fished out, if left to natural results. Shad were introduced on the Pacific coast in 1885. The cost of planting was $4,000. The annual net return is $330,000 to-day, so that one experiment at least is paying a handsome dividend. Ever since 1867 artificial reproduction has kept shad running in the Connecticut River. Shad have been planted in Atlantic coast rivers by the billions.

The result of investigating the oyster industry has been to cause the various States most concerned to pass laws regulating the beds, the size and number of oysters to be taken, and the policing of the beds. Oyster preservation and propagation differs from lobsters and shad in that oysters are not hatched from eggs away from their natural habitat. We have no oyster hatcheries. Results similar to those obtained for other fish at hatcheries are provided for oysters by better care of the beds.

Young oysters are minute larvæ that swim on the surface of the sea. Menhaden, alewives, mackerel and other surface swimming fish feed on them at this stage. Soon the young oyster sinks to the bottom of the sea and attaches itself to some object which must be clean and remain long enough for the oyster to become fixed. When food is plentiful the oyster grows rapidly and assumes a convex shape on the left side and flat on the right. Shape determines market value. Under natural conditions young oysters fasten themselves in too great numbers on the same object, crowding and killing each other as they grow. Oysters feed on minute plants and animals (even their own young) in the water. Such plants are more abundant in shallow muddy water, so the best bottom is one that is firm enough for oysters to attach themselves but must also be near a muddy section, in water not too deep to be readily warmed in the sun. Too finely divided mud, or a moving sand bottom, overwhelms the tiny oyster, suffocating it. A rocky bottom is too deficient in food. The water must not be stagnant, must not be subject to frequent flood, which dislodges the oyster, and must not be too fresh. Too much ice discolors the oyster. So the muddy bottom must be saline and influenced by tides or current to aerate the water and bring in food.

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* Shad Fisheries of Atlantic Coast. U. S. Fisheries Bureau.

Oysters have sex, reproducing like fish. The male sends milt into the water, the female, eggs. If the two genital fluids mix the eggs are fertilized, but since the oyster spawn over a long period (April-October) and as the oysters are often scattered widely over the natural beds and because there is no way of determining sex before spawning, there is great loss of eggs, for the two fluids do not meet at all or not soon enough.

The oyster has enemies both active and passive. The passive enemies are parasites which grow so rapidly as to engulf the oyster; or are other similar shell animals which eat all the oyster's food. The active enemies are boring worms which eat out the oyster's shell. Drills with their rasp tongues penetrate the shell and suck out the oyster. Drumfish, stingray, and worst of all, the star-fish eat oysters. The star-fish encircles the oyster and by muscular effort pulls the shells apart to eat the soft parts.

Man has helped the oyster by increasing the areas available for fixation by planting brush, tin cans, shells, bricks and pieces of pottery and sand in soft, muddy bottoms. By preventing crowding, breaking up clusters, many young are saved and allowed to grow into market shape. Seed oysters are planted at regular intervals over the bottom so as to assure a mixture of eggs and milt. Enemies are destroyed by fishing for them, dragging traps across the beds to catch them and by building stockades to keep the fish enemies away from the beds. Food supply has been increased by propagating the small plants which constitute 90 per cent. of what the oysters eat. Finally legal provisions are made that prevent the taking of immature oysters from the beds, or the removal of more than the natural increment in any one year. By these means extermination is prevented and a supply sufficient for the always increasing demand is made. The threatened annihilation of the oyster is thus stayed.

As the fish along the Nile were wasted by the receding waters, so along the Mississippi after floods thousands of stranded fish formerly perished. To-day these fish are collected and put back in the river or sent to stock some other station. The same class of rescue work is carried on along canals that are drained in the fall of the year. Fish alien to our waters have been introduced here.

Stress has been laid on the work of the National Commission (now the Bureau of Fisheries) because its work has been the most comprehensive. Various State Commissions have carried on similar works for their own waters, meeting the problems peculiar to their State. The State and national bureaus are interdependent, aiding and supplementing each other. States having mutual waterways, such as New Jersey and Pennsylvania, New Jersey and New York, Pennsylvania and Ohio, consult each other as to fish legislation and aid each other in fish hatching and preservation.

The oyster, the cod, the shad, the salmon and the lobster, our valuable food fishes, would soon cease to exist if the work of artificial propagation and egg hatching were not carried on by the State and National Commissions.

The fish industry employs 150,000 men and the annual value of its products is over $50,000,000.* It is taken as an illustration of the attitude toward all resources, because it so well shows all the phases through which resources pass. In regard to some of our resources we are still in the first stage. Others we are wasting thoughtlessly. Toward many we are getting uneasy and preaching conservation, but in none except fisheries have we actually taken the last step and regenerated a resource that had been lost. For this reason, fisheries are here used to illustrate the whole field.

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*Statistical Abstract U. S.